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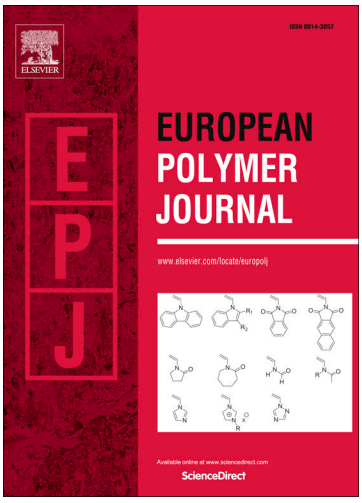


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# Charge density dependence of elasticity of anionically modified *N,N*-dimethylacrylamide-based gels with (meth)acrylic acid segments: an insight by quantitative analysis of electrostatic contributions

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**Abstract**
Swollen state properties of modified polyelectrolyte gels with anionic species is highly dependent on the effective charge density distributions as well as the interactions between the mobile and immobile groups. A more systematic and comparative study of the role of structure and content of the anionic comonomers has been made on poly(*N,N*-dimethylacrylamide) PDMAAm-based hydrogels attention being focused on their Gaussian elasticity and corresponding swollen state properties. A thermodynamic framework for interpreting gel-swelling model was presented to describe the aqueous equilibrium swelling properties of a series of weakly ionic polyelectrolyte hydrogels based on acidic comonomers; acrylic acid (AAc), methacrylic acid (MAAc), sodium acrylate (NaA) and a base monomer DMAAm as well as the effect of ionizable groups on their resulting mechanical properties. The introduction of the electrostatic interactions decreased the elastic modulus of ionic PDMAAm hydrogels and cryogels. The model predicts well the effect of the gel charge density on the elasticity; however, the correlation of the obtained results with the equilibrium swelling data suggests that a change of the gel microstructure with electrostatic interactions is the responsible of the observed background effect. Although the ionizable functional groups of AAc and MAAc display weak anionic polyelectrolyte characteristics, the swelling ratio is enhanced with respect to homopolymeric PDMAAm, increasing in the order DMAAm < MAAc < AAc < NaA.

**Keywords:** *N,N*-dimethylacrylamide, polyelectrolyte gels, osmotic pressure, effective charge density, elasticity

## 1. Introduction

Due to the versatility and vital potential for the delivery of gastric irritating drugs, investigations on the swelling equilibrium and mechanical properties of carboxylic acid containing responsive polyelectrolyte gels have attracted considerable attention both theoretically and experimentally [1-4]. Several thermodynamic models describing the complex physical processes have been applied to explain the dependence of the equilibrium swelling or collapse of polyelectrolyte gels on the effective charge density, crosslinking efficiency, hydrophilicity or hydrophobicity of the polymer network chains, type, content and $pK_a$ of ionizable groups, pH, ionic strength and valence of counter ion of the external swelling medium [5-9]. As a result of coupling between ionization degree and elasticity,